



Annual Reports :: Year 6 :: University of California, Los Angeles

Project Report: Genome Evolution and Innovation

Project Investigator:

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Project Progress

Progress has been good this year in the area of Genomic Studies. Six papers have been published in leading journals supported by the Astrobiology program. Two papers, described below, have been especially visible. As part of this work Prof. Jim Lake co-organized a special Genomics Section at the 2003 Gordon Conference on "The Origin of Life". He also helped Co-organize, with 5 others, the joint Astrobiology/Canadian Research Institute meeting held in Canada in April 2004. I also served as Co-chair of the EvoGenomics Focus group, with Blair Hedges (annual report has been submitted separately).

Horizontal Gene Transfer (HGT) Greatly Accelerates Genome Evolution and Innovation :

Through studies of whole genomes, we find that HGT is strongly influenced by genomic and environmental factors. Hence, organisms living in similar environments preferentially exchange genes with other organisms that have similar environmental parameters. As a result, we infer that HGT has accelerated prokaryotic genome innovation and evolution by a factor of about 10^4 . In practical terms, this means that the number of unique prokaryotic genes that would be "invented" in a ten thousand year period if HGT were absent can in fact be "invented" in a single year! (see Publication #3).

Conditioned Reconstruction: a method for deriving the genomic tree of life in the presence of horizontal gene transfer : Our lab has developed a new phylogenetic analysis tool that uses the presence and absence of genes to determine phylogenetic trees, just as sequence analyses use nucleotides. The method has two properties that make it unique: it is relatively unaffected by horizontal gene transfer, and it has the ability to detect "fusion" events in which a new genome is created by the fusion of the genomes of two existing organisms, hence it can detect endosymbiotic events in the evolution of life. (see Publication #1).

Roadmap Objectives

- **Objective No. 4.1: Earth's early biosphere**

- **Objective No. 4.2:** Foundations of complex life
- **Objective No. 5.1:** Environment-dependent, molecular evolution in microorganisms
- **Objective No. 5.3:** Biochemical adaptation to extreme environments